

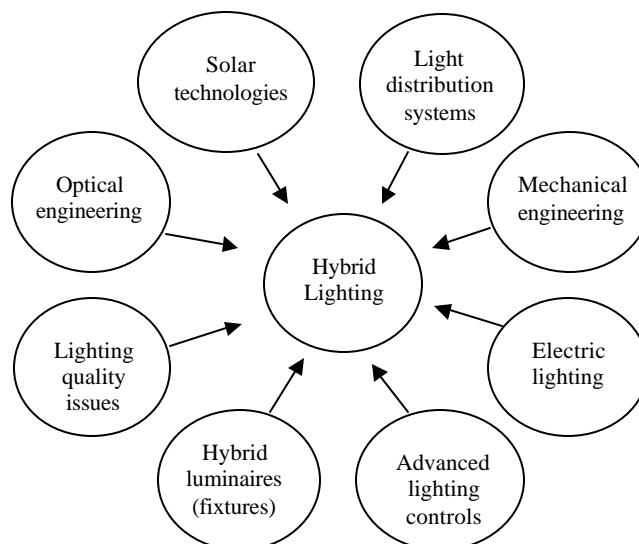
## Description of Hybrid Lighting Partnership

### Historical Background

The Oak Ridge National Laboratory (ORNL) began developing preliminary design concepts in 1995 for what is now termed hybrid lighting systems. Since then, design options have evolved considerably.

At the conclusion of the workshop, the idea of developing a public/private partnership emerged and organizers were encouraged to continue developing a hybrid lighting R&D alliance. These meetings culminated with the inclusion of hybrid lighting as a recognized DOE technology pathway for energy conservation. At first glance, one might assume that the task of developing hybrid lighting systems might be straightforward. Further investigation, however, exposes a complex series of technical issues that necessitates teaming across several vastly different scientific disciplines, as illustrated in Figure 1. Realizing the interdisciplinary nature of hybrid lighting, ORNL hosted a hybrid lighting workshop in St. Louis, Missouri, on October 2, 1996. The workshop was attended by 16 individuals, representing 10 companies and two DOE national labs (ORNL and LBNL). The purpose of the one-day workshop was to discuss key technical issues and possible teaming arrangements, develop preliminary design concepts, and identify primary and secondary market segments for hybrid lighting systems. At the conclusion of the workshop and during subsequent discussions among industry participants, the idea of developing a public/private partnership emerged, and organizers were encouraged to continue developing a hybrid lighting R&D alliance.

In July 1997, a second one-day workshop was convened in Denver, Colorado, for the purpose of further defining technical hurdles and hybrid lighting design scenarios.



**Figure 1. Technologies associated with hybrid lighting systems.**

In March 1998, Industry Week magazine selected hybrid lighting as one of the top 25 technologies of the year. ORNL's Associate Laboratory Director, Dr. R. G. Gilliland, accepted the award on behalf of ORNL from Mr. John Brandt, Industry Week's Editor-in-Chief, on March 28, 1998, at a ceremony in Chicago, Illinois.

In July 1998, a two-day hybrid lighting roadmapping and planning workshop was held in Washington, D.C., with representatives from 14 companies in attendance. Also attending were representatives from DOE EE-OUT and EE-OBT, both of whom provided a brief overview of their respective programs and road mapping activities. A portion of the industrial participants represented industry associations and technical societies including the Illumination Engineering Society, the International Association of Lighting Designers, the National Electric Manufacturers Association, the Passive Solar Industries Council, and the Solar Energy Industry Association. Several topics were discussed at the workshop including the requirements for a first generation demonstration, design criteria and issues related to each key hybrid lighting technology area, primary technical barriers, and a preliminary project plan including objectives, tasks, and schedule. Subsequent to the meeting, several participants actively contributed to the development of a draft strategic business plan that was issued in October 1998.

In October 1998, a draft version of the strategic business plan was submitted to DOE for review and comment. Soon thereafter, ORNL submitted a Field Work Statement to EE-BTS's Mr. Richard Karney. Partial funding of Phase 1 from EE-OBT was provided in late March 1999. A full description of FY 1999 progress is provided in Section 4.

During the same time frame, several hybrid lighting industry partners also participated in various scoping sessions associated with the Vision 2020 Lighting Technology Roadmapping effort led by EE-BTS's Mr. Dennis Clough. The Roadmap is intended to help chart a future course for the lighting industry. Facilitated by DOE, the roadmapping process engaged lighting industry leaders in the development of new technology solutions and business practices that meet the needs of today's and tomorrow's buildings. The vision statement that emerged from these efforts is as follows:

*In 2020, lighting systems in buildings and other applications will:*

- *Enhance the performance and well being of people;*
- *Adapt easily to the changing needs of any user;*
- *Use all sources of light efficiently and effectively;*
- *Function as true systems, rather than collections of independent components, fully integrated with other systems; and*
- *Create minimal impacts on the environment during its manufacturing, installation, maintenance, operation, and disposal.*

As a result, people will understand, value, and utilize the tangible, personal benefits provided by these lighting systems.

### **Rationale for Partnership**

There are several reasons why the Hybrid Lighting Partnership is a needed national lighting R&D initiative.

## **Lighting consumes large amounts of nonrenewable energy**

Today, lighting in U.S. residential and commercial buildings consumes close to 5 quadrillion BTUs of primary energy and one-fifth of all electricity. In commercial buildings, one-quarter of all energy demand is for lighting. With a forecasted doubling of commercial floor space by the year 2020 comes an urgent and growing need to find more efficient ways of lighting our nation's buildings.

## **Hybrid lighting is a logical technology pathway**

For this third emerging pathway, no focused national program with widespread industry involvement exists. The Hybrid Lighting Partnership fills this void. Several technology pathways exist to reduce lighting energy consumption in buildings. Three of the primary pathways include: 1) increasing the luminous efficacy of electric lamps/luminaires, 2) the development of intelligent (or adaptive) control systems that better respond to occupant needs, and 3) the development of advanced daylighting systems that better leverage available daylight, penetrate it deeper into buildings, and do so in a way that it can be cost-effectively integrated with electric lighting systems. For this third emerging pathway, no focused national program with widespread industry involvement exists. The Hybrid Lighting Partnership fills this void.

## **Hybrid lighting requires a unified approach to complex multidisciplinary R&D**

In recent years, lighting R&D has broadened in scope and now encompasses several of traditionally unrelated scientific disciplines. Consequently, new multidisciplinary lighting R&D initiatives like the Hybrid Lighting Partnership facilitate teaming of government and industry participants having relevant, value-added technical resources. Discussions on the hybrid lighting concept with over 30 lighting stakeholders identified a near unanimous belief that there is a lack of overall coordination at the national level and a need for a holistic, multidisciplinary lighting initiative of this type.

## **The aggregate benefits are large but the uncertainties too great for industry to shoulder alone**

Hybrid lighting has the potential to save large quantities of nonrenewable energy, yet it does represent a new, relatively high-risk technology pathway. Because significant improvements in key technical areas and integration of several technologies are required, leveraging of public/private resources is necessary.

## **Industry is supportive**

To date, industry has spent over \$200,000 in support of the Partnerships formation and has pledged over \$2 million in the form of in-kind R&D. The Hybrid Lighting Partnership is open to membership from U.S.-based firms and primarily consists of industry participants. Although not all individual companies are compelled to join for reasons such as existing intellectual property, all are invited to participate. To date, industry has spent over \$200,000 in support of the Partnerships formation and has pledged over \$2 million in the form of in-kind R&D. Although hybrid lighting will not displace electric lamps, it will likely lengthen the life of existing electric lamps and subsequently reduce the number of replacement lamps sold annually. As such, widespread support for the Partnership by electric lamp manufacturers is not expected.

## **Other countries are investing more**

To keep pace, the U.S. needs to mobilize its public/private resources now. Foreign investment in hybrid lighting related technologies is growing rapidly. For example, the former DOE Lighting Program Manager (Dr. Lee Anderson) once stated that Swedish government agencies are investing well over an order of magnitude more in lighting R&D relative to their GNP for new lighting technologies than we in the United States. Although no definitive figures for other countries are known, it is believed that Sweden, Japan, and Germany are all investing heavily in similar technologies. To keep pace, the U.S. needs to mobilize its public/private resources now.

## **Hybrid lighting supports multiple DOE missions**

The Hybrid Lighting Program will support the missions of DOE by:

- Increasing opportunities for improved energy conservation through efficient interior lighting;
- Reductions in greenhouse gas emissions from lowered fossil fuel use for electricity production;
- Lowering the nations reliance on hazardous materials such as mercury and lead which are environmentally undesirable; and
- Reductions in oil imports, which have almost regained their crisis levels of 1977 (46.5%).

## **Hybrid lighting broadens the support for DOE's lighting R&D program**

DOE's lighting program is one of the most under-funded research areas when compared to its impact on energy consumption in buildings. To strengthen the lighting R&D program, broad-based strategic alliances including nontraditional national lab and industry participants working on innovative, high-risk, high-payoff lighting concepts are needed. The Hybrid Lighting Partnership has been instrumental in increasing DOE's lighting R&D budget through active industry involvement.

## **The Partnership effectively utilizes DOE's existing infrastructure**

The Hybrid Lighting Partnership has been instrumental in increasing DOE's lighting R&D budget through active industry involvement. DOE has significant resources including research staff, laboratories, and equipment residing at its national laboratories that will be utilized to support the Hybrid Lighting Partnership. These include not only those resources currently supporting lighting R&D, but other resources, which will also greatly benefit the Partnership. For example, ORNL laboratories supporting fiber optics R&D, ultra precision manufacturing, optical characterization and system design, solar collectors, and coatings development will provide research leadership in a number of areas. Resources like these represent capabilities, which the lighting industry does not have within its own research infrastructure, nor does DOE at its designated lighting laboratory. These resources would be difficult to include in an industry-only R&D program or one limited to just one DOE national laboratory. Thus, a partnership between industry and government provides a synergism of interest, skills, and infrastructure that will assure the most rapid scientific progress.

Hybrid lighting represents the nations first attempt at fulfilling the vision goals described in DOE's lighting technology roadmap.

### **Hybrid Lighting is aligned with the Vision 2020 Roadmap**

Hybrid lighting represents the nation's first attempt at fulfilling the vision goals described in DOE's lighting technology roadmap. It represents the first interdisciplinary approach to interior lighting that: 1) functions as a true, integrated system rather than collections of independent components; 2) maximizes the use of natural sunlight while efficiently using electric sources in an integrated fashion, 3) more easily adapts to the changing needs of any user when compared to other daylighting approaches, 4) enhances the well-being of the users through the use of natural sunlight, and 5) creates minimal impacts on the environment during its manufacturing, installation, maintenance, operation, and disposal.

Based on results of the independent analysis, hybrid lighting has the potential to achieve 40% of the DOE Lighting R&D Program goals.

### **Hybrid Lighting helps DOE achieve its energy- savings goals**

Based on results of the independent analysis, hybrid lighting has the potential to achieve 40% of the DOE Lighting R&D Program goals for energy savings and associated GHG emission reductions.